FAST DATA ACQUISITION SYSTEM FOR BOOSTER SUPPLIES READBACK

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Abstract

Booster synchrotron at RRCAT is used to inject electron beam in Synchrotron Radiation Sources - Indus-1 & Indus-2. Booster gets 20 MeV beam from Microtron, ramps up its energy to 450/550 MeV which is then extracted for injection in Indus-1/Indus-2. The Ramping cycle repeats every second. For this, various magnet power supplies are fed reference voltage & current waveforms synchronously and accordingly they feed the magnets with current for ~800 msec. A system was required to synchronously capture data of all power supplies to on cycle to cycle basis. Global machine data monitoring system polling data at 1 Hz cannot acquire sufficient points to do this. So a VME and PC based system has been developed for parallel and fast capture of data from 13 such power supplies.

INTRODUCTION

There are 13 power supplies in the booster which participate in the ramping process to increase electron beam energy from 20 MeV to 450/550 MeV. Successful operation of booster depends upon the synchronous, reliable and reproducible performance of these power supplies. The development of fast, synchronous data acquisition system provides simultaneously captured waveform data sets for all the power supplies. This data provides quantitative measurement of power supply performance regarding the reproducibility of ramp waveforms and tracking between them. The hardware has been developed on VME platform consisting of CPU (68040), 12 bit ADC cards and control card. User can select- permit to capture, start delay, samples and time interval between samples. Advantages are - Isolated, simultaneous capturing on 13-channels, capturing synchronized with an event and selectable capturing-rate and samples. The CPU board on the VME runs RTOS OS-9 and control program on PC is developed using LabVIEW.

SCHEME OF THE DATA ACQUISITION SYSTEM

The implemented scheme has two-tier architecture. The first layer has a PC and the second layer has a VME station. The two communicate over Ethernet using TCP/IP sockets. A control program in LabVIEW® runs on the PC. The VME-station has a CPU board, 13 ADC boards and a Control board as shown in Figure 1.

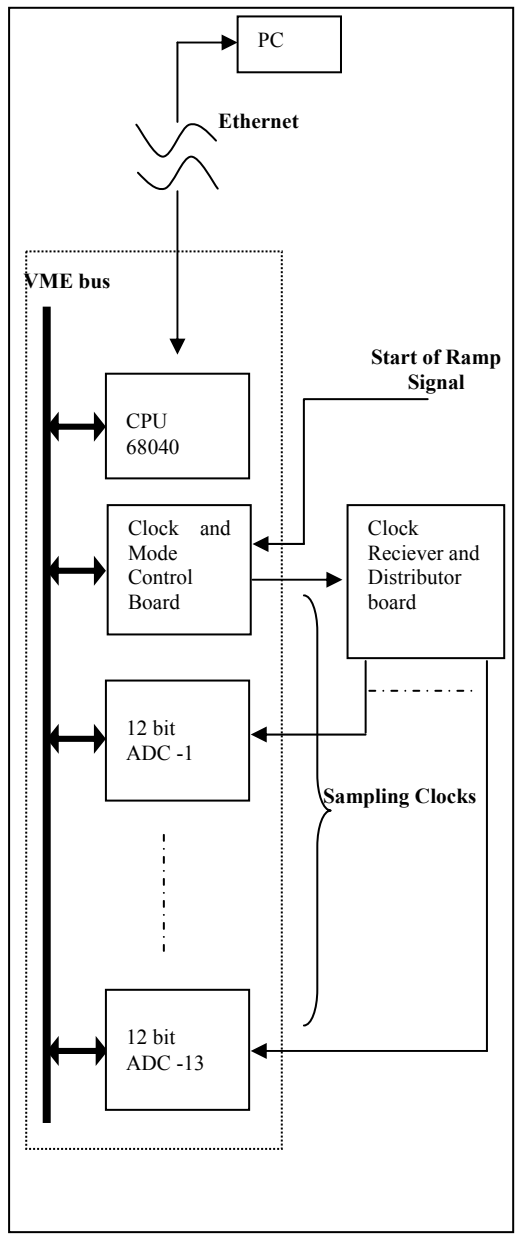

Figure 1: Scheme of Data Acquisition System.

The ADC board has a 12-bit sampling ADC with conversion rate of 100 KSPS and analog input range of 0-10 V. There is also a FIFO memory of size 8 K words on each ADC board. The board converts the input analog signal and stores the digitized data in this memory in response to an external trigger. The data that is captured in FIFO is read by the CPU.

There is a Clock and Mode 'Control Board' in the VME station. The CPU writes/ reads on this board to set the

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various modes and parameters related to the data capturing scheme. The ranges/values of the various parameters are:

- Permit capturing: ON / OFF
- Sampling Delay: 20 µsec to 200 msec
- Sampling interval: 20 µsec to 10 msec
- No. of Samples: 256, 512, 1K, 2K, 4K and 8K words.

The CPU board is Motorola® MVME-162 board based on 68040 Microprocessor with Real Time Operating System OS-9® ported on it.

OPERATION OF THE DATA ACQUISITION SYSTEM

The 'Start of Ramp' signal is connected to the input of 'Control Board'. The card responds to this input if the 'Permit Capturing' parameter is set to ON. In response to this input and as per the parameters set, the card outputs the clock pulses. These clock pulses are given to a 'Clock Receiver and Distributor Board' that duplicates this input clock on its 13 output channels. Each output channel is connected to one ADC card and this clock acts as the trigger for the ADC card. The parameter 'Sampling interval' decides the frequency of the clock and 'Samples to be captured' decides the number of clock pulses.

The OS-9 application program on the CPU Board communicates with control program running on PC. It receives various commands and acts on them. It sets the parameters on the 'Control Board'. It reads the FIFOs on ADC boards and sends back the captured data. This program accesses various VME cards using the OS-9 Device Drivers.

The control program running on the on the PC has following functionalities:

- Operation mode selection.
- Get data and represent it in graphical form.
- Selectable plotting of multiple graphs.
- Logging of data with comments from operator

Presentation of the captured ramp data waveforms in graphical form is shown in Figure 2.

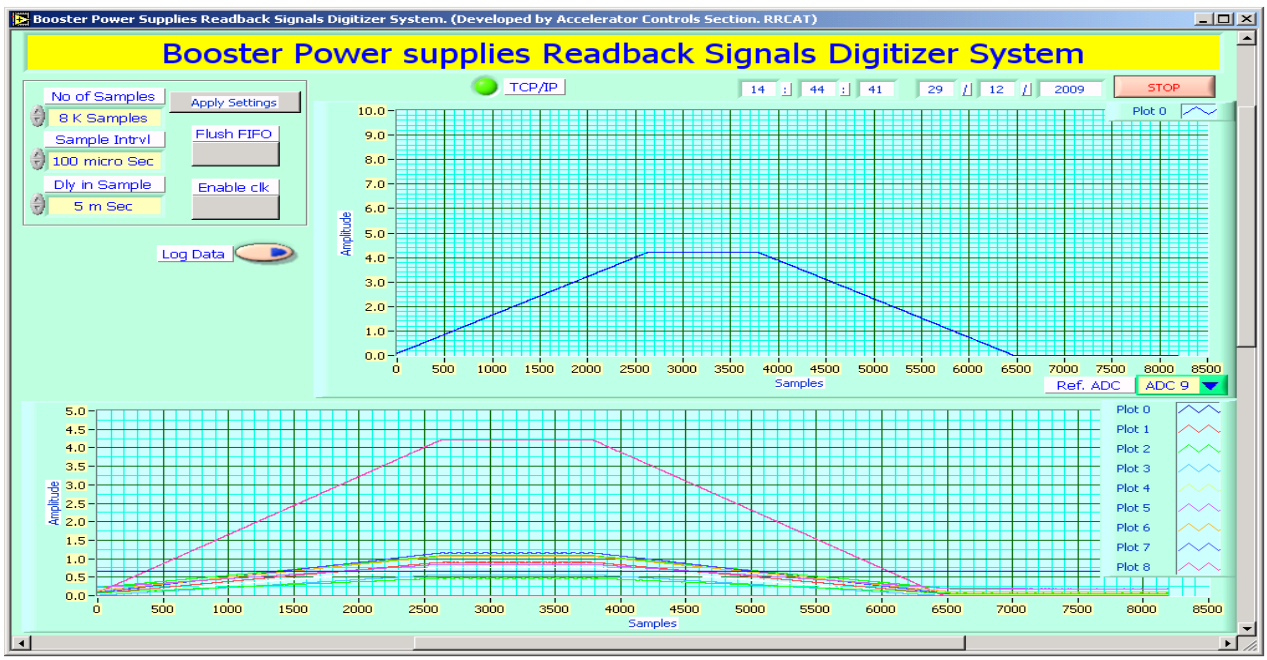

Figure 2: Graphical representation of captured ramp data waveforms.

RESULTS AND CONCLUSION

The Fast data acquisition has been deployed in the Booster hall and has been interfaced with the power supplies. The data captured form the system is often analyzed to investigate the operation of the Booster system. Future plan includes extending the FIFO memory on the ADC in order to capture more samples at higher sampling rates, comparing captured waveform with the reference and automatic report generation for the captured waveform.

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